

**DEPARTMENT OF TRANSPORTATION  
UNITED STATES COAST GUARD**

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NAVIGATION AND VESSEL INSPECTION CIRCULAR NO. 6-84

Subj: Automated Main and Auxiliary Machinery; Supplemental Guidance on

1. PURPOSE. The purpose of this Circular is to provide guidance to Coast Guard marine inspectors on the application of NVIC No. 1-69, "Automated Main and Auxiliary Machinery" and the amendments to SOLAS 1974 (1st set), chapters II-i and 11-2.
2. APPLICABILITY. This Circular applies to the following categories of vessels that utilize automated main or auxiliary machinery, regardless of manning:
  - a. Vessels for which the keels are laid or at a similar stage of construction on or after 1 September 1984, and in international service.
  - b. Vessels to which NVIC 10-81 applies, in international service, and -
    - (1) For which a major alteration, modification, or repair contract is placed; or
    - (2) In absence of such a contract, applies for a Certificate of Inspection or commences major alteration, modification, or repair;on or after 1 September 1984.
  - c. All self-propelled vessels, other than small passenger vessels (Subchapter T) and offshore supply vessels, that -
    - (1) Undergo initial Coast Guard inspection for certification; or
    - (2) Are Coast Guard certificated and inspected and undergo major alteration, modification, or repair;on or after the effective date of this Circular.
3. DISCUSSION.
  - a. NVIC 1-69 is the Coast Guard's existing guidance for automated machinery plants. Enclosure (1) to the NVIC primarily addresses steam plants. Its lack of conceptual guidance in certain areas and lack of specific diesel propulsion guidance makes it inadequate for many present applications.

- b. The first set of amendments to SOLAR, 1974 enter into force internationally on 1 September 1984 and apply to vessels in international service. These amendments provide both specific and general requirements for machinery space automation and periodically unattended machinery spaces. The automation-related SOLAR amendments (encl.(I)) are:

Chapter 11-1, Regulations 26.2, 26.3, 26.4, 26.6, 26.7, 27.1, 27.5, 31 (all), 32.2, 32.3, 32.4, 37, 46 (all), 47 (all), 48 (all), 49 (all) 50, 51 (all), 52, 53 (all), 54.


Chapter 11-2, Regulation 4.3.4.3, 4.3.4.4, 4.9, 11.5, 11.7, 11.8, 14 (all), 15.5.

In several areas, these requirements closely parallel the guidance of NVIC 1-69. In other areas, they are a significant departure and are more stringent.

- c. A notice of proposed rulemaking for automated vital systems will be published soon. The Coast Guard intends to incorporate into the regulations for all vessels, other than small passenger vessels and offshore supply vessels, the requirements of SOLAS, the general concepts of NVIC 1-69, specific requirements for diesel, steam, and other propulsion systems, and both the provisions and means to determine equivalent levels of safety and reliability.

#### 4. ACTION.

- a. All vessels in categories 2.a. and 2.b. should follow the applicable guidance of NVIC 1-69 and should meet the applicable SOLAR amendments listed. Where a conflict exists between SOLAR and the guidance of NVIC 1-69 or between SOLAR and the applicable regulations in Title 46, Code of Federal Regulations, SOLAR standards' must be applied in order for the vessel to be eligible for a SOLAR Certificate.
- b. NVIC 1-69 and the SOLAR amendments should be applied, as guidance, to all vessels in category 2.c. Where a conflict exists between SOLAR and the applicable regulations in Title 46, Code of Federal Regulations, the vessel must meet or exceed the regulatory requirements.
- c. In all cases, the general concepts and considerations of SOLAR and NVIC 1-69 should be emphasized. These include alternate means of control, continuity of vital services, flooding and fire safety, failsafe controls and alarms, detection and tripping of unsafe machinery conditions, communications, maintenance, testing, proven performance, and reliability.
- d. All parties should be aware that this Circular and NVIC 1-69 are guidelines. Alternate equipment or operating arrangements that provide an equivalent degree of safety are acceptable. Where the SOLAR amendments and NVIC 1-69 do not provide adequate specific detail, the Officer in Charge, Marine Inspection should discuss alternatives with the owner or the owner's representative and reach a decision that is subject to the appellate process, as set forth in NVIC 16-82, "Appeal of Coast Guard Commercial Vessel Decisions and Actions".
- e. Where the SOLAR amendments reference sections of SOLAR not listed above, such as automatic fire detection systems in SOLAR 11-2/14, refer to the applicable U.S.C.G. regulation or NVIC.

  
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End: (1) Excerpts, Amendments to the International Convention for the Safety of Life at Sea, 1974 (SOLAR)

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Excerpts, Amendments to the International Convention for the Safety of Life at Sea, 1974 (SOLAR)

Chapter 11-1, Regulation-

PART C - MACHINERY INSTALLATIONS  
(Except where expressly provided otherwise Part C  
applies to passenger ships and cargo ships)

26 General.

26.2 The Administration shall give special consideration to the reliability of single essential propulsion components and may require a separate source of propulsion power sufficient to give the ship a navigable speed, especially in the case of unconventional arrangements.

26.3 Means shall be provided whereby normal operation of propulsion machinery can be sustained or restored even though one of the essential auxiliaries becomes inoperative. Special consideration shall be given to the malfunctioning of:

- .1 a generating set which serves as a main source of electrical power;
- .2 the sources of steam supply;
- .3 the boiler feed water systems;
- .4 the fuel oil supply systems for boilers or engines;
- .5 the sources of lubricating oil pressure;
- .6 the sources of water pressure;
- .7 a condensate pump and the arrangements to maintain vacuum in condensers;
- .8 the mechanical air supply for boilers;
- .9 an air compressor and receiver for starting or control purposes;
- .10 the hydraulic, pneumatic or electrical means for control in main propulsion machinery including controllable pitch propellers.

However, the Administration, having regard to overall safety considerations, may accept a partial reduction in propulsion capability from normal operation.

26.4 Means shall be provided to ensure that the machinery can be brought into operation from the dead ship condition without external aid.

26.6 Main propulsion machinery and all auxiliary machinery essential to the propulsion and the safety of the ship shall, as fitted in the ship, be designed to operate when the ship is upright and when inclined at any angle of list up to and including 15° either way under static conditions and 22.5° under dynamic conditions (rolling) either way and simultaneously inclined dynamically (pitching) 7.5° by bow or stern. The Administration may permit

deviation from these angles, taking into consideration the type, size and service conditions of the ship.

- 26.7 Provision shall be made to facilitate cleaning, inspection and maintenance of main propulsion and auxiliary machinery including boilers and pressure vessels.

27 Machinery.

- 27.1 Where risk from overspeeding of machinery exists, means shall be provided to ensure that the safe speed is not exceeded.

- 27.5 Main turbine propulsion machinery and, where applicable, main internal combustion propulsion machinery and auxiliary machinery shall be provided with automatic shut-off arrangements in the case of failures such as lubricating oil supply failure which could lead rapidly to complete breakdown, serious damage or explosion. The Administration may permit provisions for overriding automatic shut-off devices.

31 Machinery controls.

- 31.1 Main and auxiliary machinery essential for the propulsion and safety of the ship shall be provided with effective means for its operation and control.

- 31.2 Where remote control of propulsion machinery from the navigating bridge is provided and the machinery spaces are intended to be manned, the following shall apply:

- .1 the speed, direction of thrust and, if applicable, the pitch of the propeller shall be fully controllable from the navigating bridge under all sailing conditions, including maneuvering (sic):
- .2 the remote control shall be performed, for each independent propeller, by a control device so designed and constructed that its operation does not require particular attention to the operational details of the machinery. Where multiple propellers are designed to operate simultaneously, they may be controlled by one control device;
- .3 the main propulsion machinery shall be provided with an emergency stopping device on the navigating bridge which shall be independent of the navigating bridge control system;
- .4 propulsion machinery orders from the navigating bridge shall be indicated in the main machinery control room or at the maneuvering (sic) platform as appropriate;
- .5 remote control of the propulsion machinery shall be possible only from one location at a time; at such locations interconnected control positions are permitted. At each-location there shall be an indicator showing which location is in control of the propulsion machinery. The transfer of control between the navigating bridge and machinery spaces shall be possible only in the main machinery space or the main machinery control room. This system shall include means to prevent the propelling thrust from altering significantly when transferring control from one location to another;

- .6 it shall be possible to control the propulsion machinery locally, even in the case of failure in any part of the remote control system;
  - .7 the design of the remote control system shall be such that in case of its failure an alarm will be given. Unless the Administration considers it impracticable the preset speed and direction of thrust of the propeller shall be maintained until local control is in operation;
  - .8 indicators shall be fitted on the navigating bridge for:
    - .8.1 propeller speed and direction of rotation in the case of fixed pitch propellers;
    - .8.2 propeller speed and pitch position in the case of controllable pitch propellers;
  - .9 an alarm shall be provided on the navigating bridge and in the machinery space to indicate low starting air pressure which shall be set at a level to permit further main engine starting operations. If the remote control system of the propulsion machinery is designed for automatic starting, the number of automatic consecutive attempts which fail to produce a start shall be limited in order to safeguard sufficient starting air pressure for starting locally.
- 31.3 Where the main propulsion and associated machinery, including sources of main electrical supply, are provided with various degrees of automatic or remote control and are under continuous manual supervision from a control room the arrangements and controls shall be--go designed, equipped and installed that the machinery operation will be as safe and effective as if it were under direct supervision; for this purpose Regulations 46 to 50 shall apply as appropriate. Particular consideration shall be given to protect such spaces against fire and flooding.
- 31.4 In general, automatic starting, operational and control systems shall include provisions for manually overriding the automatic controls. Failure of any part of such systems shall not prevent the use of the manual override.
- 32 Steam Boilers and Boiler Feed Systems.
- 32.2 Each oil-fired boiler which is intended to operate without manual supervision shall have safety arrangements which shut off the fuel supply and give an alarm in the case of low water level, air supply failure or flame failure.
  - 32.3 Water tube boilers serving turbine propulsion machinery shall be fitted with a high-water-level alarm.
  - 32.4 Every steam generating system which provides services essential for the safety of the ship, or which could be rendered dangerous by the failure of its feed water supply, shall be provided with not less than two separate feed water systems from and including the feed pumps, noting that a single penetration of the steam drum is acceptable. Unless overpressure is prevented by the pump characteristics means shall be provided which will prevent overpressure in any part of the systems.

- 37 Communication between navigation bridge and machinery space.

At least two independent means shall be provided for communicating orders from the navigating bridge to the position in the machinery space or in the control room from which the engines are normally controlled: one of these shall be an engine room telegraph which provides visual indication of the orders and responses both in the machinery space and on the navigating bridge. Appropriate means of communication shall be provided to any other positions from which the engines may be controlled.

#### PART E - ADDITIONAL REQUIREMENTS FOR PERIODICALLY UNATTENDED MACHINERY SPACES

(Part E applies to cargo ships except that Regulation 54  
refers to passenger ships)

- 46 General.

- 46.1 The arrangements provided shall be such as to ensure that the safety of the ship in all sailing conditions, including maneuvering (sic), is equivalent to that of a ship having the machinery spaces manned.
- 46.2 Measures shall be taken to the satisfaction of the Administration to ensure that the equipment is functioning in a reliable manner and that satisfactory arrangements are made for regular inspections and routine tests to ensure continues reliable operation.
- 46.3 Every ship shall be provided with documentary evidence, to the satisfaction of the Administration, of its fitness to operate with periodically unattended machinery spaces.

- 47 Fire precautions.

- 47.1 Means shall be provided to detect and give alarms at an early stage in case of fires:
- .1 in boiler air supply casings and exhausts(uptakes); and
  - .2 in scavenging air belts of propulsion machinery,
- unless the Administration considers this to be unnecessary in a particular case.
- 47.2 Internal combustion engines of 2250 kW and above or having cylinders of more than 300 mm bore shall be provided with crankcase oil mist detectors or engine bearing temperature monitors or equivalent devices.

- 48 Protection against flooding.

- 48.1 Bilge wells in periodically unattended machinery spaces shall be located and monitored in such a way that the accumulation of liquids is detected at normal angles of trim and heel, and shall be large enough to accommodate easily the normal drainage during the unattended period.

- 48.2 Where the bilge pumps are capable of being started automatically, means shall be provided to indicate when the influx of liquid is greater than the pump capacity or when the pump is operating more frequently than would normally be expected. In these cases, smaller bilge wells to cover a reasonable period of time may be permitted. Where automatically controlled bilge pumps are provided, special attention shall be given to oil pollution prevention requirements.
  - 48.3 The location of the controls of any valve serving a sea inlet, a discharge below the water-line or a bilge injection system shall be so sited as to allow adequate time for operation in case of influx of water to the space, having regard to the time likely to be required in order to reach and operate such controls. If the level to which the space could become flooded with the ship in the fully loaded condition so requires, arrangements shall be made to operate the controls from a position above such level.
- 49 Control of propulsion machinery from the navigating bridge.
- 49.1 Under all sailing conditions, including maneuvering, the speed, direction of thrust and, if applicable, the pitch of the propeller shall be fully controllable from the navigating bridge.
    - 49.1.1 Such remote control shall be performed by a single control device for each independent propeller, with automatic performance of all associated services, including, where necessary, means of preventing overload of the propulsion machinery.
    - 49.1.2 The main propulsion machinery shall be provided with an emergency stopping device on the navigating bridge which shall be independent of the navigating bridge control system.
  - 49.2 Propulsion machinery orders from the navigating bridge shall be indicated in the main machinery control room or at the propulsion machinery control position as appropriate.
  - 49.3 Remote control of the propulsion machinery shall be possible only from one location at a time; at such locations interconnected control positions are permitted. At each location there shall be an indicator showing which location is in control of the propulsion machinery. The transfer of control between the navigating bridge and machinery spaces shall be possible only in the machinery space or in the machinery control room. The system shall include means to prevent the propelling thrust from altering significantly when transferring control from one location to another.
  - 49.4 It shall be possible for all machinery essential for the safe operation of the ship to be controlled from a local position, even in the case of failure in any part of the automatic or remote control systems.
  - 49.5 The design of the remote automatic control system shall be such that in case of its failure an alarm will be given. Unless the Administration considers it impracticable, the preset speed and direction of thrust shall be maintained until control is in operation.
  - 49.6 Indicators shall be fitted on the navigating bridge for:
    - .1 propeller speed and direction of rotation in case of fixed pitch propellers; or



.2 propeller speed and pitch position in case of controllable pitch propellers.

49.7 The number of consecutive automatic attempts which fail to produce a start shall be limited to safeguard sufficient starting air pressure. An alarm shall be provided to indicate low starting air pressure set at a level which still permits starting operations of the propulsion machinery.

## 50 Communication.

A reliable means of vocal communication shall be provided between the main machinery control room or the propulsion machinery control position as appropriate, the navigating bridge and the engineer officers' accommodation.

## 51 Alarm system.

51.1 An alarm system shall be provided indicating any fault requiring attention and shall:

- .1 be capable of sounding an audible alarm in the main machinery control room or at the propulsion machinery control position, and indicate visually each separate alarm function at a suitable position;
- .2 have a connection to the engineers' public rooms and to each of the engineers' cabins through a selector switch, to ensure connection (sic) to at least one of those cabins. Administrations may permit equivalent arrangements;
- .3 activate an audible and visual alarm on the navigating bridge for any situation which requires action by or attention of the officer on watch;
- .4 as far as is practicable be designed on the fail-to-safety principle; and
- .5 activate the engineers' alarm required by Regulation 38 if an alarm function has not received attention locally within a limited time.

51.2.1 The alarm system shall be continuously powered and shall have an automatic change-over to a stand-by power supply in case of loss of normal power supply.

51.2.2 Failure of the normal power supply of the alarm system shall be indicated by an alarm.

51.3.1 The alarm system shall be able to indicate at the same time more than one fault and the acceptance of any alarm shall not inhibit another alarm.

51.3.2 Acceptance at the position referred to in paragraph 1 of any alarm condition shall be indicated at the positions where it was shown. Alarms shall be maintained until they are accepted and the visual indications of individual alarms shall remain until the fault has been corrected, when the alarm system shall automatically reset to the normal operating condition.

## 52 Safety systems.

A safety system shall be provided to ensure that serious malfunction in machinery or boiler operations, which presents an immediate danger, shall initiate the automatic shut-down of that part of the plant and that an alarm shall be given. Shut-down of the propulsion system shall not be automatically activated except in cases which could lead to serious damage, complete breakdown, or explosion. Where arrangements for overriding the shut-down of the main propelling machinery are fitted, these shall be such as to preclude inadvertent operation. Visual means shall be provided to indicate when the override has been activated.

53 Special requirements for machinery, boiler and electrical installations.

53.1 The special requirements for the machinery, boiler and electrical installations shall be to the satisfaction of the Administration and shall include at least the requirements of this Regulation.

53.2 The main source of electrical power shall comply with the following

53.2.1 Where the electrical power can normally be supplied by one generator, suitable load shedding arrangements shall be provided to ensure the integrity of supplies to services required for propulsion and steering as well as the safety of the ship. In the case of loss of the generator in operation, adequate provision shall be made for automatic starting and connecting to the main switchboard of a stand-by generator of sufficient capacity to permit propulsion and steering and to ensure the safety of the ship with automatic re-starting of the essential auxiliaries including, where necessary, sequential operations. The Administration may dispense with this requirement for a ship of less than 1,600 tons gross tonnage, if it is considered impracticable.

53.2.2 If the electrical power is normally supplied by more than one generator simultaneously in parallel operation, provision shall be made, for instance by load shedding, to ensure that, in case of loss of one of these generating sets, the remaining ones are kept in operation without overload to permit propulsion and steering, and to ensure the safety of the ship.

53.3 Where stand-by machines are required for other auxiliary machinery essential to propulsion, automatic change-over devices shall be provided.

53.4 Automatic control and alarm system.

53.4.1 The control system shall be such that the services needed for the operation of the main propulsion machinery and its auxiliaries are ensured through the necessary automatic arrangements.

53.4.2 An alarm shall be given on the automatic change-over.

53.4.3 An alarm system complying with Regulation 51 shall be provided for all important pressures, temperatures and fluid levels and other essential parameters.

53.4.4 A centralized control position shall be arranged with the necessary alarm panels and instrumentation indicating any alarm.

53.5 Means shall be provided to keep the starting air pressure at the required level where internal combustion engines are used for main propulsion.

54 Special consideration in respect of passenger ships.

Passenger ships shall be specially considered by the Administration as to whether or not their machinery spaces may be periodically unattended and if so whether additional requirements to those stipulated in these Regulations are necessary to achieve equivalent safety to that of normally attended machinery spaces.

#### Chapter 11-2, Regulation -

4 Fire Pumps, Fire Mains, Hydrants and Hoses.

4.3.4 The arrangements for the ready availability of water supply shall be:

- .3 in cargo ships with a periodically unattended machinery space or when only one person is required on watch there shall be immediate water delivery from the fire main system at a suitable pressure either by remote starting of one of the main fire pumps with remote starting from the navigating bridge and fire control station, if any, or permanent pressurization of the fire main system by one of the main fire pumps, except that the Administration may waive this requirement for cargo ships of less than 1,600 tons gross tonnage if the arrangement of the machinery space access makes it unnecessary;
- .4 in passenger ships, if fitted with periodically unattended machinery spaces in accordance with Regulation 11-1/54, the Administration shall determine provisions for fixed water fire-extinguishing arrangement for such spaces equivalent to those required for normally attended machinery spaces.

4.9 Location and arrangement of water pumps, etc., for other fire extinguishing systems.

Pumps required for the provision of water for other fire-extinguishing systems required by this Chapter, their sources of power and their controls shall be installed outside the space or spaces protected by such systems and shall be so arranged that a fire in the space of spaces protected will not put any such system out of action.

11 Special arrangements in machinery spaces.

11.5 The controls required in paragraph 4 and in Regulation 15.2.5 shall be located outside the space concerned, where they will not be cut off in the event of fire in the space they serve. In passenger ships such controls and the controls for any required fire-extinguishing system shall be situated at one control position or grouped in as few positions as possible to the satisfaction of the Administration. Such positions shall have a safe access from the open deck.

11.7 For periodically unattended machinery spaces in cargo ships, the Administration shall give special consideration to maintaining fire integrity of the machinery spaces, the location and

centralization of the fire-extinguishing system controls, the required shut-down arrangements (e.g. ventilation, fuel pumps, etc.) and may require additional fire-extinguishing appliances and other fire-fighting equipment and breathing apparatus. In passenger ships these requirements shall be at least equivalent to those of machinery spaces normally attended.

- 11.8 An approved automatic fire detection and alarm system complying with the provisions of Regulation 14 shall be fitted in any machinery space:
  - .1 where the installation of automatic and remote control systems and equipment has been approved in lieu of continuous manning of space; and
  - .2 where the main propulsion and associated machinery including sources of main electrical supply are provided with various degrees of automatic or remote control and are under continuous manned supervision from a control room.
- 14 Fixed fire detection and fire alarm systems for periodically unattended machinery spaces.
  - 14.1 A fixed fire detection and fire alarm system in accordance with the relevant provision of Regulation 13 shall be installed in periodically unattended machinery spaces.
  - 14.2 This fire detection system shall be so designed and the detectors so positioned as to detect rapidly the onset of fire in any part of those spaces and under any normal conditions of operation of the machinery and variations of ventilation as required by the possible range of ambient temperatures. Except in spaces of restricted height and where their use is specially appropriate, detection systems using only thermal detectors shall not be permitted. The detection system shall initiate audible and visual alarms distinct in both respects from the alarms of any other system not indicating fire, in sufficient places to ensure that the alarms are heard and observed on the navigating bridge and by a responsible engineer officer. When the navigating bridge is unmanned the alarm shall sound in a place where a responsible member of the crew is on duty.
  - 14.3 After installation the system shall be tested under varying conditions of engine operation and ventilation.
  - 15.5 Periodically unattended machinery spaces.

In addition to the requirements of paragraphs 1 to 4, the oil fuel and lubricating oil systems shall comply with the following:

- .1 Where necessary, oil fuel and lubricating oil pipelines shall be screened or otherwise suitably protected to avoid as far as practicable oil spray or oil leakages on to hot surfaces or into machinery air intakes. The number of joints in such piping systems shall be kept to a minimum and, where practicable, leakages from high pressure oil fuel pipes shall be collected and arrangements provided for an alarm to be given.
- .2 Where daily service oil fuel tanks are filled automatically, or by remote control, means shall be provided to prevent overflow spillage.. Other equipment which treats flammable liquids automatically, e.g. oil fuel purifiers, which, whenever

practicable, shall be installed in a special space reserved for purifiers and their heaters, shall have arrangements to prevent overflow spillages.

- .3 Where daily service oil fuel tanks or settling tanks are fitted with heating arrangements, a high temperature alarm shall be provided if the flashpoint of the oil fuel can be exceeded.